

Attached Appendix A

- **Host and Network Monitoring:**
 - Collection of Data via Operating System Calls for Minimal Intrusiveness
 - Common Data Formats Across Platforms
 - Distribution of Host and Network Statuses and Performance Histories
 - Discovery of Distributed Environment Configuration Changes
 - Detection of Host Failure
 - Detection of Host Startup
- **Application-Level Instrumentation:**
 - Low-Overhead Application API's
 - Common User-Specified Instrumentation Data Formats
 - Data Collection and Distribution Architecture
 - Grammar-Driven Event Correlation
- **System Specifications:**
 - Modeling of Application Systems
 - Structure, Capabilities, and Configuration
 - Requirements and Inter-Dependencies
 - Modeling of Hardware and Network Systems
 - Structure, Capabilities, and Configuration
 - Run-Time Access to Specification Information
 - Run-Time Loading of Specification Information
 - Run-Time Access via Object-Oriented API
- **Resource Allocation Decision-Making:**
 - Determination of Application-to-Host Mappings
 - Recovery from Hardware and Software Failures
 - Detection of and Recovery from Software Performance Problems
 - Control of Application Scalability
 - Reallocation of Applications to Hosts
 - Reallocation of Applications to Hosts based on Priority Changes
 - Application-to-Host Mappings for New Required Applications
 - Selection of Applications to be Shutdown
 - Resolution of Inter-Application Startup Dependencies
- **Resource Control:**
 - Startup, Shutdown, and Configuration of Distributed Applications
 - Interactive Operator Control via Operator Display
 - Creation of Defined System Configurations
 - Loading of Pre-defined System Configurations
 - Startup, Shutdown, and Configuration of Individual Applications
 - Automatic Control via Resource Manager Orders
 - Failure Detection Capabilities
 - Application Failure Detection via Interrupt Notification
 - Host Failure Detection via Internal Heartbeat Mechanism
- **Displays / Visualization:**
 - Host Configuration and Performance
 - Network Configuration and Performance
 - Application Software Performance
 - Resource Allocation Decisions and State Information
 - Software Status and Configuration
 - User-Configurable Instrumentation Display
 - Near Real-Time Display of Information
- **Middleware**
 - Reliable Message Passing
 - Location-Transparent TCP Client-Server Configuration
 - Automated Connections and Reconnections
 - Client and Server detection via UDP multicast
 - Many-to-Many Client-Server Connections supported
 - Message Callback Function Registration
 - TCP Connection Status Change Callback Function Registration

Attached Appendix B:

1) Event data message header:

```
long total_bytes           // total number of bytes in the event data message
long message_type          // message type designator *
char version[8]            // version of Instrumentation APIs *
char test_name[24]         // test name for this event
double timetag            // time stamp of when this event data message was sent
unsigned int gm_time       // GMT time stamp
unsigned int event_num     // event number
char process_name[24]      // name of application sending event data message
long pid                  // process id of application sending event data message
char host_name[64]         // host name that application is running on
long ip_addr              // ip address of host
long tid                  // task id of application sending event data message
unsigned int thread_type   // thread type
unsigned int sequence_num  // sequence number of the event data message
double time_in_client      // time the API was called to create event data message
double time_server_received // time the Instrumentation Daemon read in this event data message
double time_server_sent    // time the Instrumentation Daemon sent event data message to the Instrumentation Collector
```

2) The event data message format string contains data field names and format specifiers for each data field. The following data specifiers (borrowed from ANSI C) are supported:

```
%*r : raw data, user defined, and number of bytes
%hi : short signed 16 bit integer
%hd : short signed 16 bit integer
%hu : short unsigned 16 bit integer
%li : long signed 32 bit integer
%ld : long signed 32 bit integer
%lu : long unsigned 32 bit integer
%lf : IEEE double precision floating point - signed 64 bit floating point
```

- %s : null-terminated string data
- %c : character
- %f : IEEE single precision floating point - signed 32 bit floating point
- %i : signed 32 bit integer
- %d : signed 32 bit integer
- %u : unsigned 32 bit integer

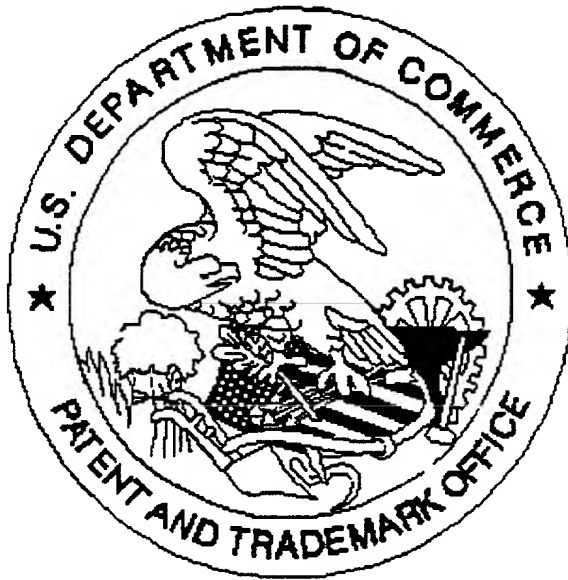
Event string example: "StartTime %.f StopTime %.f TrackNumber %u Hostname %s"

3) The data fields are then packed using the MessageBuffer class described in Appendix A of the RMComms Middleware Design Report.

Attached Appendix C

Class	Description
TCPCommClient	<p>RMComms client server communication client services:</p> <ul style="list-style-type: none"> ▪ client configuration <ul style="list-style-type: none"> - client name, server port number, network interface to use (optional) ▪ connection and disconnection to servers <ul style="list-style-type: none"> - all servers, specific servers, or servers on specific hosts ▪ sending user-defined messages to connected servers <ul style="list-style-type: none"> - send to all servers or only to specific servers ▪ receiving user-defined messages from connected servers <ul style="list-style-type: none"> - registration of message handler callback functions for specific messages - polled or asynchronous message delivery ▪ monitoring of server connection statuses <ul style="list-style-type: none"> - queries to determine connected server statuses - notification of new server connections or broken server connections
TCPCommServer	<p>RMComms client-server communication server services:</p> <ul style="list-style-type: none"> ▪ server configuration <ul style="list-style-type: none"> - server name, server port number, network interface to use (optional) ▪ connection to new clients ▪ sending user-defined messages to connected clients <ul style="list-style-type: none"> - send to all clients or only to specific clients ▪ receiving user-defined messages from connected clients <ul style="list-style-type: none"> - registration of message handler callback functions for specific messages - polled or asynchronous message delivery ▪ monitoring of client connection statuses <ul style="list-style-type: none"> - queries to determine connected client statuses - notification of new client connections or broken client connections
TimeUtils	<p>Clock access and time conversion services:</p> <ul style="list-style-type: none"> ▪ read system clock time ▪ time conversions between GMT and local time ▪ time conversions to hours, minutes, seconds, day, month, year
SignalRegistry	<p>User-defined signal (interrupt) handler registration services:</p> <ul style="list-style-type: none"> ▪ register a signal handler function for a specified signal <ul style="list-style-type: none"> - invoked when interrupt occurs ▪ unregister a signal handler function for a specified signal

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